NOTES ON THE FERTILISATION OF SOME AUSTRALIAN AND OTHER PLANTS.

By A. G. Hamilton.

(Plate xxvi.)

PITTOSPOREÆ.

Pittosporum undulatum, *Andr.*—I have (3) given an account of the two forms of flowers noticed in this plant—1st, those with perfect stamens and pistils; 2nd, those with perfect pistils, but having stamens very short and converted into nectaries, and not functional as pollen-bearers. Since then, I have seen a tree in Dr. Lee's garden in Wollongong which sprang up as a seedling among ferns transplanted from the bush. In this tree the stamens are perfect but the pistil is imperfect and never sets seed. This completes the series of forms.

T. Kirk (2, p. 81) says of *Pittosporum eugenioides*, A. Cunn., "In this species the flowers are in many specimens practically unisexual: although both stamens and pistil are invariably present, one or other is abortive. The perfect stamens have longer and more slender filaments, and produce abundance of pollen: the imperfect stamens are carried on shorter, less slender filaments, and produce but little pollen. The pistil exhibits but little variation. Flowers with perfect and imperfect stamens may be produced on different trees, or both forms may be found on the same tree associated with perfect flowers: in the former case the trees are practically diœcious. Other New Zealand species of *Pittosporum* exhibit the same phenomenon."

Pittosporum undulatum has manifestly reached a farther stage of differentiation, as the various forms are never found on one tree, so far as my experience extends; the anthers in the second

form are always quite abortive, having only a couple of dozen ill-formed pollen-grains in the sacs, which never open, and the anthers are mere honey-secretors. The filaments are very short, almost suppressed.

In the other Illawarra species, *P. revolutum*, Ait., I have never seen any approach to this state of affairs. All the flowers are perfect.

PHYTOLACCEÆ.

Phytolacca octandra, *Linn.*—This introduced plant spreads very freely in the Illawarra District. It is proterandrous, but the stigmas soon open and become mature, while the anthers retain their pollen for a long time. I have seen it visited by small pollen-eating beetles once or twice, but it is mostly self-fertilised. Every flower without exception is succeeded by a fruit. The flowers have a strong herbaceous smell, not at all sweet. Its rapid spread is accounted for by the fondness of birds for the fruits. They are eaten by the regent-bird, cat-bird, satin bird, several species of *Ptilotis*, the crow-shrike, and the domestic fowl. The fruit colours the excrement deeply, and the shining black seeds pass through the alimentary canal uninjured. The plant springs up most plentifully in ground that has been cleared by burning or on the site of camp fires, a fact that gives it one of its American vernacular names "fire-weed."

LEGUMINOSÆ.

Erythrina Indica, *Lam.*—The stamens are ten, nine below united, and one above. Of the nine lower stamens, five are long and four shorter. At the base of each filament is a gland, the ten forming a ring exterior to the insertion of the stamens. The glands secrete a rather bitter nectar freely. The calyx-lobes are united into a tube and form a receptacle for the honey. The corolla has a twist in it so that it is at an angle to the central line of the calyx and peduncle. The colour is bright scarlet, a hue often found in bird-fertilised flowers. At Mount Kembla, as I have already noted elsewhere (3), the plants never bear seed. I have repeatedly pollinated stigmas with the pollen of their own

flowers, of flowers from other branches, and from distant trees, with the result that although the ovulary swelled for a time, it ultimately dropped off. Practically, however, even using pollen from distant trees was the same as taking it from the same individual, as all the trees in the neighbourhood were taken as cuttings from the same parent tree. The clusters of flowers are large and very conspicuous, and the main crop is borne in winter and early spring when the trees are leafless, but flowers may be found on individual trees at almost any season. The clusters of flowers are visited by *Acanthorhynchus tenuirostris*, various species of *Ptilotis* and *Strepera graculina*. *Ptilotis* is especially fond of them, and numbers of these birds spend the day in the trees, probing the flowers and chasing each other about. With a butterfly net I captured one which flew into the house through an open window. On holding it in my hand and offering it a flower it immediately inserted its beak and cleaned out the calyx with its brush-tipped tongue and afterwards when set free in the room not only sucked flowers (if the expression sucked may be allowed) but took honey from a spoon and drank water freely when a glass was offered to it. It is to these birds that the pollination of the stigmas is mostly due, I think, as they are just of the right length of beak and head to gather pollen from the projecting stamens. In sucking the honey they insert the beak on the inner side of the curved petals, and the force they exert in pressing it causes the anthers to rub against the throat of the bird, depositing pollen there, which is transferred to the stigmas of other blossoms.

Belt (4, p. 130) gives an account of the pollination of the Palosabre (a South American species of *Erythrina*) by humming birds, which agrees in the main with the above, except that he does not mention any twist in the flowers, and that the chief object of the birds is the capture of insects which resort to the flowers. I have never seen bees visit the flowers of *E. indica*, but small beetles and flies frequent them, and are, no doubt, sought for by the birds. Müller (1, p. 215) quotes Darwin's statement on the authority of MacArthur that in N.S. Wales

Erythrina does not produce good fruit unless the flowers be shaken. He also mentions two species which are pollinated by humming-birds and one in which the process is performed by bees.

VITIFERÆ.

Vitis Baudiniana, *F.v.M.*—The four petals have the margin near the apex folded over to form a little hood. The four stamens are inserted on the base of the petals. The disk has a raised rim, inside of which and opposite to each stamen is secreted a single drop of nectar. The flowers are greenish, and are much frequented by a number of species of Diptera which carry pollen from flower to flower and deposit it on the stigma.

COMPOSITÆ.

Helichrysum lucidum, *Henck*.—In this plant the flowerets open on the circumference of the flower first, and the opening proceeds towards the centre. The open flowerets form a ridge all round the centre. They are much frequented by native bees in the middle and latter part of the summer. The insects work round the flower with legs straddling the raised rim, dipping their proboscides in each floweret, and stopping where there is nectar for a considerable time. In this way there is no doubt they fertilise the plant. I have also observed one of the blues, *Holochila Heathi*, Cox, working on the plant in the same way.

CAMPANULACEÆ.

Lobelia dentata, *Cav.*—In this plant the flowers are very bright blue, with white guide-lines on the anterior and two lateral petals; but pale pink and pure white colour-varieties are not uncommon. The posterior petals and the laterals have short, thick-headed hairs scattered over their surface (fig. 1). The anthers, as in others of the genus, are tipped with white silvery hairs (fig. 2) and cohere into a tube (fig. 3). In the earlier stages of the flower, the stigma lies at the bottom of the tube, its lobes closer and from the base of the stigma outside springs a row of stiff beaded hairs (fig. 4). When the anthers begin to dehisce,

the style lengthens rapidly and the ring of hairs round base of stigma sweeps the pollen out of the anthers and pushes it out at the orifice of the tube. At this stage the tip of the tube is hidden behind the posterior petals. Insects visiting the flowers force the posterior lobes of the corolla asunder, and pushing against the top of the tube are invariably dusted with pollen hanging to the anther-hairs. When the anthers are emptied of pollen the style lengthens so as to protrude between the posterior corolla-lobes, and the stigmatic lobes open (fig. 5) and are then ready to receive pollen from insect visitants. Haviland describes the process in *L. anceps*, Thunb., *L. gracilis*, Andr., *L. gibbosa*, Labill., and *L. debilis* (**5**, p. 182). I do not, however, find the latter plant named in Baron von Mueller's Second Census of Australian Plants. Pollen is always found scattered all over the lateral and anterior petals. The latter acts as a landing-stage for visitors.

PLANTAGINEÆ.

Plantago lanceolata, *Linn.*—Hermann Müller (**1**, p. 503) quotes Delpino's opinion that this species is a transitional form between anemophilous and entomophilous pollen-bearing plants. The latter observer in support of his theory describes three varieties which he noticed. First, the tall scaped form with very long and thin filaments; second, a hill-growing plant with shorter scape, but still essentially anemophilous; third, a mountain form with very short scape, short spikes and filaments, which were much visited by bees which collected the pollen. He goes on—"This therefore is a form of *Plantago* which hangs between the anemophilous and entomophilous conditions, and is capable of being fertilised equally well by the wind and by bees. If the filaments became stiff and coloured and the pollen grains adhesive, while the anthers lost their peculiar quivering, we should have before us the passage from anemophilous to entomophilous characters, the evolution of an entomophilous from an anemophilous species. This hypothetical transition has actually occurred. *Plantago media* is a form that has become entomophilous; the filaments have become pink, the anthers are motionless, the pollen

grains have become more aggregated, and it is visited regularly by *Bombus terrestris*."

I have been fortunate enough to find a head of *P. lanceolata* at Mount Kembla which shows a further stage in the evolution of the entomophilous from the anemophilous condition. The plant was growing in a bare exposed situation, and as usual under such conditions the scape was short—about 5 cm. in length, the usual height being 20 to 40 cm. The scape was growing almost horizontally from the centre of the leaves, curving up slightly in the last 2 or 3 cm. The flowers presented the usual structure in all but one point. Instead of the usual very long and slender filaments, 7-10 mm., the anthers seemed to be sessile (fig. 6). Closer examination showed that they had short filaments (about 1·5 mm.) which were entirely hidden in the tube of the flower The anthers were very full of pollen, but I could see no difference between them and those of flowers with long filaments on other plants. The flowers were proterogynous as in the ordinary form, and in the second stage the stigma was red, withered and either hidden in the centre of the four anthers or lying closely pressed between them and the petals. The anthers were very easily detached.

Although this was probably an accidental variation, yet it marks the line along which the evolution of entomophilous flowers might proceed in this species. Such a condition might well conduce to a number of heads being fertilised by bees with pollen from the new form, and the variation might thus be perpetuated for a generation. If the new race had any advantage from the altered structure, it might become fixed and so another step towards truly entomophilous flowers would be taken.

PLANTAGO VARIA, *R. Br.*—This, like the other species of the genus, is proterogynous. the stigmas in the lower part of the head protruding from the closed flowers first (fig. 7) and the higher flowers successively following the same course. After a time the petals open and the stamens come out (fig. 8). The petals have a good deal of crimson on the centre line and all round the throat of the tube, and the calyx-segments have apical spots of the same

colour. The filaments are about 1 mm. long out of the tube. The stigma is red. I have seen a head visited by small insects, either flies or bees, but they were so rapid in their movements that I could not determine which.

ASCLEPIDIACEÆ.

Marsdenia flavescens, *Cunn.*—The individual flowers are small and dull-coloured, but as they grow in large and close umbels they are on the whole conspicuous. The scent is very rich and strong; and they produce abundance of honey. They are frequented by various species of flies, bees and butterflies, the latter almost always belonging to either the Lycænidæ or the Hesperidæ. I have not observed in any of the visiting insects the pollinia attached, and the plant does not fruit freely—three or four per cent., at most, of the flowers setting seed. A plant well in flower is a good lure, and the butterfly collector will find a visit to such on a warm day well repaid.

LABIATÆ.

Plectranthus parviflorus, *Henck.*—The flowers are arranged in fours like whorls, in a spike. The upper lip has three or four lobes; the lower lip is entire and deeply concave. The colour is purplish-blue and the flowers are sweet-scented. The stamens are four, two long and two short. They are mature before the stigma. When the flower opens the anthers are bent upwards above the concave lip (fig. 9), while the style with its as yet unopened stigma lies at the bottom of the concavity. Insects visiting the flowers at this stage take up pollen on their under surface. When the anthers have discharged all their pollen they bend down into the cup of the lower lip, while the style bending upwards takes their place, the stigma opening at the same time (fig. 10). In this stage the stigmas rub against insects and, taking up the pollen, are fertilised. The insects seen visiting are *Taractrocera papyria*, Boisd., and *Lycæna labradus*, Godt. The plants seed very freely. They flower almost all the year round.

The flower stalks, peduncles and calyx are closely covered with trichomes of two forms (fig. 11).

References to Literature.

(1) Mueller (Herm.)—The Fertilisation of Flowers (1883).

(2) Kirk, T.—Forest Flora of New Zealand (1889).

(3) Hamilton, A. G.—"On the Fertilisation of some Australian Plants." Aust. Assoc. Adv. Science Report. Vol. vi. 1895.

(4) Belt, T.—"The Naturalist in Nicaragua." 1st Ed.

(5) Haviland, E.—"Occasional Notes on Plants indigenous to the neighbourhood of Sydney." P.L.S.N.S.W., 1883. Vol. viii.

EXPLANATION OF PLATE.

Lobelia dentata.

Fig. 1.—Hairs on petals.
Fig. 2.—Hairs on anther-tips.
Fig. 3.—Tube of stamens enclosing style.
Fig. 4.—Hairs round base of stigma.
Fig. 5.—Tube of stamens: stigma protruding and open.

Plantago lanceolata.

Fig. 6.—Flower with short stamens.

Plantago varia.

Fig. 7.—First, or male stage, of flower.
Fig. 8.—Second, or female, stage.

Plectranthus parviflorus.

Fig. 9.—Flower in first stage.
Fig. 10.—Flower in second stage.
Fig. 11.—Trichomes from stem, calyx and backs of petals.